

Apollo 16 Orbital Mass Spectrometer Experiment

Instrument Overview

The objective of Apollo 16 Orbital Mass Spectrometer (OMS), a composition experiment, was to use the measured concentrations to study the sources, sinks, and transport mechanisms of the lunar ambient atmosphere. This flight neutral magnetic mass spectrometer was similar to that flown on Apollo 15. On Apollo 17, a mass spectrometer was deployed on the lunar surface for the same purpose.

The spectrometer was deployed from the Scientific Instrument Module on the Service Module. It was mounted at the end of a retractable boom, which, when fully extended, measured 7.3 meters. This distance was expected to be beyond the outgassed molecular cloud. Control of the experiment functions and the boom motion was provided by a set of command module switches that were operated by a crew member according to the mission time line or by instruction from the ground controller. A scoop mounted on the top of the package was the gas inlet plenum. This inlet was oriented along the spacecraft velocity vector for maximum ram effect when ambient measurements were obtained, and it was oriented in the wake direction to determine background spectra and instrument outgassing. Pre-flight absolute calibration was done at the Langley Research Center Molecular Beam Facility.

Instrument Operation

For the Apollo 16 flight, the inlet structure was fitted with a thermally controlled inner plenum, which was heated to approximately 250 degrees Celsius for 1 hour before operation to outgas the structure. Subsequently, the temperature was kept at 70 degrees Celsius during data collection. Two mass ranges, 12 to 28 and 28 to 67 atomic mass units, were scanned simultaneously because this analyzer had two collectors. Ions of a given mass, when focused on one of the collectors, were counted for a period of 0.1 second, and then the accumulated count was telemetered. Formation of the ions at the junction of the gas inlet plenum and analyzer was accomplished by an electron beam with 70 electron volts of energy. The flight instrument was calibrated in a molecular beam facility to determine the absolute sensitivity factors. For most gases, one count corresponded to 260 molecules per cubic centimeter. An important exception was neon, for which one count corresponded to 1100 atoms per cubic centimeter in the lunar atmosphere. These sensitivity numbers were applicable only when the inlet faced in the direction of motion. Owing to a boom malfunction approximately 200 hours after launch, the mass spectrometer was jettisoned before trans earth injection. Some preliminary results and more experiment detail can be found in Hodges et al. (1972).

References

Apollo Scientific Experiments Data Handbook, NASA Technical Memorandum X-

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Yeager, P. R., A. Smith, J. J. Jackson, and J. H. Hoffman, Absolute Calibration of Apollo Lunar Orbital Mass Spectrometer. Journal of Vacuum Science and Technology, Volume 10, Number 2, pp. 348 – 354, 1973. DOI: 10.1116/1.1317064.

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